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ABSTRACT

Ohio State University and the University of Cincinnati have collaborated on development and presentation of a team-taught course on nuclear power plant systems and operations; the course is offered to students at both universities through interactive video. This paper discusses the following lessons learned and recommendations: (1) successful presentations depend upon equipment and communication links functioning properly; (2) careful attention to classroom layout, particularly camera placement, is important; (3) use of an electronic classroom places significant additional responsibilities on instructors over traditional teaching methods; (4) it is a non-trivial matter to understand the operation and maintenance of equipment and the integrated performance of the classroom; (5) situations will arise which prevent a session from proceeding; (6) effective use of multi-media requires a greater degree of preparation and presents additional logistical problems; (7) changes in teaching style are needed if students are to actively participate; (8) coordination among instructors is required to ensure all aspects of a course are adequately carried out; (9) students and faculty both benefit from having teaching responsibility shared among faculty from two universities; and (10) working on a common project facilitated further collaboration between the universities. Future plans and improvements are also discussed. Contains 10 references. (DLS)

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Collaborative Distance Learning Using Interactive Video: Lessons Learned From the University of Cincinnati/ Ohio State University Experience

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Introduction

The Ohio State University (OSU) and the University of Cincinnati (UC) have collaborated on the development and presentation of a team-taught course related to the design and operation of the mechanical, electrical, thermal-hydraulic, and control systems used to operate commercial nuclear power plants (Christenson, et al. 1994). The course, Nuclear Power Plant Systems and Operations, is a two-quarter course offered to seniors and graduate students at both universities through interactive video. Two faculty members from each university participated in the development of the course and preparation of course materials. The faculty felt a team-taught course would provide significant improvements over a single university offering since each instructor had a unique set of academic and industrial experiences which could positively impact the course. Expertise and experience among the group encompassed plant operations, probabilistic risk assessment, system design and engineering, and nuclear power instrumentation and control.

The syllabus was developed such that approximately half of the lectures originated from each university. Generally, each lecture features only one instructor, but on occasion, instructors at both universities contribute toward a particular topic. Instructors encourage and respond to inquiries and comments from students in both the local and remote classrooms. Each of the instructors share in writing exam questions, but the exams are administered by one faculty member at each university. Grades are assigned independently at the universities as well.

The video classrooms are housed within the engineering colleges at both universities. The classrooms are essentially identical in their layout and furnishings. They are equipped with cameras, microphones, projection devices, video cassette players, monitors, and the electronics required to transmit and receive various signals from remote locations. The OSU and UC classrooms are connected via an interactive video network administered by the Ohio Aerospace Institute. This network is a two-way, interactive, full duplex system which utilizes compressed digital video technology. Local loop connections are provided by local telecommunications companies while a central provider is responsible for bandwidth and circuit switching.

Lessons Learned/Recommendations

The team-taught course described is a fairly rare application of distance learning and represents the first time either the University of Cincinnati or The Ohio State University had

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undertaken team-teaching over an interactive video network. As in any new undertaking, there were a number of challenges to overcome in successfully implementing the technology and coordinating the efforts of the participants. With the use of distance learning as a pedagogical framework increasing (Chronicles of Higher Education, 1995), we felt a compilation of the lessons learned from our experience would benefit the larger academic community. These lessons are enumerated below.

- Distance learning using an interactive video network requires the use of electronic equipment, telecommunication services (equipment and service providers), and possibly personal computers or a local computer network. Successful presentations are dependent upon each piece of equipment functioning properly and all communication links operating appropriately. If there is a failure in equipment or service, students at the remote site will not participate in that class session.

  Recommendation: Prior to each class period, the video network should be functionally tested by verifying operation of equipment in each classroom and the communication links between the classrooms. If computer hardware and software used during the presentation are maintained by someone other than the instructor, proper functioning of the devices and programs should be performed prior to their use.

- Careful attention to classroom layout, particularly the placement of cameras, is important. It is very advantageous for the lecturer to have a real-time image of the students in the remote classroom. Likewise, providing quality audio and video signals to the students in the remote classroom improves learning and promotes student interest.

  Recommendation: If possible, individuals who will be using the electronic classrooms should be actively involved in the design and layout of the classroom. The design process should involve individuals who have experience with distance learning techniques and technology. Shields (1995) provides a useful overview of some of the technologies available for distance learning applications while Chiricozzi et al. (1995) provide a very detailed discussion of classroom equipment and communication protocols.

- Use of an electronic classroom for distance learning places significant additional responsibilities on the instructors over traditional teaching methods. Instructors must verify proper operation of the classroom and communication links (see item above); provide hard copies of any hand out materials to students at the remote site; and ensure that visuals used are of sufficient quality to be appropriate for use over a video network.

  Recommendation: Instructors should allow additional preparation time when involved in distance learning courses. Presentation materials should be reviewed and updated as needed to meet the needs of video presentations. Handout material should be provided to the instructor at the remote site on a predetermined schedule (two days prior to each class has worked well). As noted above, proper functioning of the interactive video network should be performed.

- The classroom described contains a significant amount of electronic equipment. It is a non-trivial matter to understand the operation and maintenance of individual pieces of equipment and the integrated performance of the classroom.

  Recommendation: A centralized office should maintain a staff of two or three individuals who have been trained to operate and maintain the classroom and who are familiar with

the types of problems that may be encountered. These individuals should be available during functionality testing of the classrooms and at the start of each class period.

- Regardless of the advance preparations and technical support available, situations will arise which prevent a distance learning session from proceeding (e.g. local thunderstorms which make the video network unusable, sudden illness of the lecturer at the originating site, equipment failure, etc.).

  Recommendation: Faculty at both sites must be prepared with contingency plans if problems exist with the network or classrooms, or if the individual providing the lecture for that session is not available. Possible contingency plans include substituting another lecture for the one planned, having a different faculty member present the material, reconvening at another time, or taping the lecture at the originating site and then providing the tape to the other university. The point cannot be made too strongly that faculty at both universities must be prepared for a variety of problems if the students are to be properly served.

- As reported in the literature (Felder and Silverman, 1988; Daily and Daily, 1994) we have found that use of multi-media promotes student interest in the course material and can increase students' retention of subject matter. However, effective use of multi-media presentations requires a greater degree of preparation by the instructor and presents additional logistical problems in an electronic classroom. The instructor needs to both use the devices for presentation correctly and ensure that the proper image(s) have been selected for display on the video network.

  Recommendation: Instructors should increase the use of multi-media and improve their effectiveness at this type of presentation by increasing their proficiency at using the various devices in the classroom. It is often necessary to rehearse for a class session when multiple techniques of information dissemination are used.

- Students have indicated (through informal class evaluations and group interviews following the course) that traditional lecture presentations are particularly unengaging for students at the remote site. Changes in teaching style are needed if students are to actively participate in the distance learning process (Hajek, 1995).

  Recommendation: Instructors should avoid lecture-only presentations. Instructors should also seek to incorporate mechanisms for active learning which involve students at both the local and remote sites. Mehta (1995) describes one simple method for active learning which can be applied to distance learning courses, while James (1996) provides a compilation of useful instructional tips (also see Cates, 1992).

- When a single course has multiple instructors participating in the delivery of the course, a good deal of coordination is required to ensure all aspects of the course are adequately carried out. The amount of coordination required is still greater when the instructors are from different universities. Coordinating which instructor gives which lecture at any class period is only a small part of the logistical oversight needed. Homework assignments and exams must be formulated by all instructors involved in teaching the particular subject matter.

  Recommendation: The participants should interact frequently prior to offering the course to develop an appropriate syllabus which delineates both the subject matter and

instructor for each class period. The syllabus should also define when homework is to be assigned and collected, and when exams are to be administered. We have found conference calls to be an effective mechanism for interaction. In addition, one individual should be identified as the person with final responsibility for preparing the exams and distributing the exams to both universities.

- Students and faculty both benefited from having teaching responsibility shared among faculty from two universities. Students benefited from having instructors with diverse backgrounds and experience present topics they knew extremely well. The faculty benefited by being able to dedicate significant amounts of time on individual class presentations since no one instructor had to prepare all the lectures for the class. The participating universities each provide an engineering course to their students with less than normal use of faculty resources.

  Recommendation: Team-teaching of courses should be utilized as appropriate.

- Although each of the instructors contributing to the class had a good deal of knowledge on the subject matter, each of us learned a great deal more about aspects of the material because of the collaboration. Working together on a common project has facilitated further collaboration between the two universities.

  Recommendation: Collaborations between faculty at different universities should be pursued to the extent practical.

Future Plans

Further improvements to the classroom layout and facilities are being pursued. It would be advantageous to free the instructor from some of the responsibilities of equipment manipulation required for effective use of the electronic classroom. Automatic tracking of the instructor's movements by the camera would allow for more freedom of movement and better interaction between the instructor and students. Improvements to the equipment used to present multi-media are also being sought. Items that allow better utilization of Internet resources are of particular interest.

The instructors are investigating mechanisms to improve the teaching styles used in the electronic classroom. We hope to identify relevant techniques in the literature and through discussions with individuals in communications related fields. A formal implementation and evaluation of pertinent techniques is anticipated.

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Autobiographical Sketches

Mr. Eugene Rutz is a Research Associate and an Adjunct Assistant Professor of Nuclear Engineering in the Department of Mechanical, Industrial and Nuclear Engineering at the University of Cincinnati. Mr. Rutz is a 1982 graduate of the UC undergraduate nuclear engineering program and also has an M.S. in Mechanical Engineering as well as a Professional Engineer's license. Currently, Mr. Rutz's primary responsibility is coordination and development of distance learning programs in the College of Engineering. Mr. Rutz has over 15 years experience in industry and university research in diverse fields including nuclear power plant preoperational and startup testing, design of mechanical components, stress analysis, and human health risk analysis. He was responsible for the initial development of a dual-level course on nuclear power plant systems that is currently taught on a collaborative basis by UC and the Ohio State University. Professor Rutz is an active member of the University's Health and Environmental Risk Institute where he provides risk assessment for radioactively contaminated sites.

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Mr. Brian Hajek received his MS in Nuclear Engineering from The Ohio State University in 1972, and a BS in Physics and BA in Math from Otterbein College in 1966. He is the author or

coauthor of more than 50 papers, presentations, and technical reports. Mr. Hajek has worked in industry, government, and education during his professional career and has been active in professional activities as a member of the American Nuclear Society, Health Physics Society, and Sigma Xi. At The Ohio State University, Professor Hajek has taught courses in nuclear instrumentation, hydraulics and measurements, and a BWR systems course that includes ten weeks of on-campus coursework for graduate students in nuclear engineering, followed by one week of on-site simulator operation. He is currently managing a project that is a cooperative effort among Ohio State University, the University of Cincinnati, the U.S. Department of Energy, and Ohio industry to develop university courseware on power plant operating principles using the full-function plant simulators at three currently operational nuclear power plants.